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मानक

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Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

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Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 15140 (2003): Automotive Vehicles - Safety Belt Assembly
[TED 6: Automotive Body, Chassis, Accessories and Garage
Equipments]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

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“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

स्वचल वाहन — सुरक्षा पेटी समुच्चय — विशिष्टि

Indian Standard

AUTOMOTIVE VEHICLES —
SAFETY BELT ASSEMBLY — SPECIFICATION

ICS 43.040.60

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Body, Chassis, Accessories and Garage Equipment Sectional Committee had been approved by the Transport Engineering Division Council.

In the preparation of this standard considerable assistance has been taken from the Automotive Industries Standard, AIS-005/2000 Automotive vehicles — Safety Belt Assemblies — Specifications (including Amendment No. 1 of May 2002) prepared by the Automotive Industry Standards Committee set up by the Ministry of Road Transport and Highways, Government of India. AIS-005/2000 is further based on ECE Regulation-16 “Safety Belts and Restraint Systems”, 2000/3/EC “Motor Vehicle Safety Belts” and JIS:D-4604-1988 “Seat Belts for Automobiles”.

In Annex D the following ASTM/ISO Standards have been referred to for which at present there is no parallel Indian Standard:

ASTM D2000	Standard classification system for rubber products in automotive applications
ISO 4582 : 1998	Plastics — Determination of change in colour and variations in properties after exposure to daylight under glass, natural weathering or laboratory light sources.
ISO 6487 : 1987	Road vehicles — Measurement techniques in impact test — Instrumentation

Seat belt is a safety item for the passengers in case of sudden deceleration and accidents. Seats and their design, mounting, etc, contribute substantially to the riding comforts of the vehicle users. Seat belts have become mandatory fitment on front seats of M and N categories of vehicles from April 1994 in India.

The composition of the Committee responsible for formulation of this standard is given in Annex E.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 1 JUNE 2006
TO
IS 15140 : 2003 AUTOMOTIVE VEHICLES — SAFETY
BELT ASSEMBLY — SPECIFICATION

(*Page 1, clause 1, fourth line*) — Substitute 'separate use that is, as individual fittings' for 'use, that is'.

(*Page 1, clause 3.1, eighth line*) — Substitute ' ; the term also embraces,' for 'which is'.

(*Page 1, clause 3.1*) — Insert at the end 'These may be of following types.'

(*Page 1, clause 3.1.2, last line*) — Delete the word '(Inertia)'.

(*Page 4, clause 3.12*) — Substitute the following for the existing clause:

'Either a bench type seat or seats which are separate but side by side (i.e. fixed so that front seat anchorages of one of these seats are in line of rear anchorages of the other or between the anchorages of the other seat) and accommodate one or more seated adult persons.'

(*Page 4, clause 3.15, line 2*) — Substitute 'seat assembly' for 'seat belt assembly'.

[*Page 4, clause 3.23(a)*] — Insert the word 'etc' after 'retractors'.

(*Page 4, clause 4.1.2, last line*) — Substitute 'in Table 1' for 'below'.

(*Page 4, clause 4.1.3*) — Substitute the following for the existing clause:

'The belt or restraint system shall be so designed and constructed that when correctly installed and properly used by an occupant, its satisfactory operation is assured and it reduces the risk of body injury in event of an accident.'

(*Page 5, table*) — Insert the following above the table:

'Table 1
(Clause 4.1.2)'

(*Page 5, clause 4.1.5*) — Insert the following at the end of clause:

'It shall also allow the belt to be tightened with one hand to suit the wearer's body size and the position of the vehicle seat.'

Amend No. 1 to IS 15140 : 2003

(*Page 5, clause 4.2.1.4, fourth and fifth sentence*) — Substitute 'assessed' for 'checked'.

(*Page 5, clause 4.2.2.1, first sentence*) — Substitute the following for the existing:

'The buckle shall be designed as to be easy to grasp and use and preclude any possibility of incorrect use.'

(*Page 5, clause 4.2.2.2, fourth sentence*) — Substitute the following for the existing:

'The buckle shall be released by pressing a button or activating a similar device.'

(*Page 5, clause 4.2.2.6*) — Delete this clause and renumber the following clause 4.2.2.7 as 4.2.2.6.

[*Page 7, clause 4.2.5.4(a)*] — Substitute the following for the existing matter:

'After being submitted to corrosion testing in accordance with 5.1, the pre-loading device (including the impact sensor connected to the device by the original plugs but without any current passing through them) shall operate normally.'

(*Page 7, clause 4.3.3*) — Insert the following at the end of clause:

'The test agency conducting the tests may dispense with one or more of these tests if the composition of the material used or information already available renders the test or tests superfluous.'

(*Page 7, clause 4.3.4.1, second sentence*) — Substitute the following for the existing:

'For both the samples, it shall be equal to at least 75 percent of the average of the breaking strength determined during tests on unbraided straps and not less than the minimum load specified for the item being tested.'

(*Page 7, clause 4.3.4.2, third line*) — Substitute 'in Table 2' for 'below'.

(*Page 7, table*) — Insert the following above the table:

'Table 2
(*Clause 4.3.4.2*)'

(*Page 8, clause 4.3.6, line 2*) — Substitute 'Table 3' for 'below'.

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(Page 8, table) — Insert the following above the table:

'Table 3
(Clause 4.3.6)'

(Page 8, clause 4.4.1) — Substitute '*Static Strength/Displacement Test on Seat Belt Assembly/Restraint Systems (not Applicable for ELR Belt)*' for '*Static Strength Displacement Test (not Applicable for ELR Belt)*'.

(Page 8, clause 4.4.2.7, second sentence) — Substitute the following for the existing:

'However if the belt adjustment device for height consists of belt anchorage itself, it shall conform to IS 15139, provision of 5.5.2.1 may apply.'

(Page 9, clause 5, line 3) — 'Table 4' for 'Table 1'.

(Page 10, Table 1) — Substitute 'Table 4' for 'Table 1'.

(Page 11, clause 5.2.8.3) — Insert the following at the end of the clause:

'A typical arrangement is shown in Fig. 11 for reference.'

(Page 14, clause 5.4.2.7.2, first sentence) — Substitute 'in Table 5' for 'below'.

(Page 14, Table) — Insert the following above the table:

'Table 5
(Clause 5.4.2.7.2)'

(Page 15, clause 5.4.4, third sentence) — Substitute the following for the existing:

'The work load per unit elongation is obtained by dividing the work load area (ABD) produced by the tension load curve from the time of initial load to that of final load by the gauge length at the time of initial load.'

(Page 16, clause 5.5.1.2, last sentence) — Substitute 'shall be' for 'may be'.

(Page 16, clause 5.5.1.4, third sentence) — Substitute 'shall be' for 'may be'.

(Page 19, clause 5.5.2.5, first sentence) — Substitute 'test agency' for 'Inspection agency'.

(Page 19, clause 5.5.3.3, first sentence) — Substitute ' $(600/n)N$ ' for ' $600n/N$ '.

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(*Page 21, clause A-5.2*) — Add the following after the heading:

'Number and Position of Safety Belts and Restraint Systems and Seats on which They can be Used (see Table 6)'

(*Page 21, table*) — Insert the following above the table:

'Table 6

(*Clause A-5.2*)'

(*Page 22, clause B-1.1, first sentence*) — Substitute the following for the existing:

'The apparatus shall consist of a mist chamber, a salt solution reservoir, supply of suitable conditioned compressed air, one or more atomizing nozzles, samples support, provision of heating the chamber and necessary means of control.'

(*Page 26, clause D-5.1.1*) — Substitute 'Table 7' for 'Table 2' and 'Table 8' for 'Table 3'.

(*Page 30, Table 2*) — Substitute 'Table 7' for 'Table 2'.

(*Page 31, Table 3*) — Substitute 'Table 8' for 'Table 3'.

(TED 6)

Indian Standard

AUTOMOTIVE VEHICLES — SAFETY BELT ASSEMBLY — SPECIFICATION

1 SCOPE

This standard specifies the requirements of safety belt assemblies and restraint systems which are designed for installation in motor vehicles of category M and N and intended for use, that is, by a person of adult built occupying forward and rearward facing seats.

2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	Title
3400	Methods of test for vulcanized rubbers:
(Part 4) : 1987	Accelerated ageing (<i>second revision</i>)
(Part 9) : 1978	Density (<i>first revision</i>)
(Part 18) : 1999	Stiffness at low temperature (Gehman test) (<i>first revision</i>)
11939 : 1998	Automotive vehicles — Steering control systems — Impact protection requirements and method of measurements
14272	Automotive vehicles — Types — Terminology: Part 1 Three and four wheelers
(Part 1) : 1995	
15139 : 2002	Automotive vehicles — Safety belt anchorages — Specification

3 TERMINOLOGY

For the purposes of this standard, the following terms and definitions shall apply.

3.1 Safety Belt/Seat Belt/Belt — An arrangement of straps with a securing buckle, adjusting devices and attachments which are capable of being anchored to the interior of a motor vehicle and designed to diminish the risk of injury to the wearer in the event of collision or of abrupt deceleration of the vehicle, by limiting the mobility of the body of wearer. Such an assembly is known as a 'belt assembly' which is any device for energy absorption or belt retraction.

3.1.1 Two Point (Lap) Belt — A belt which passes across the front of the pelvic lap region of the wearer and constructed so as to extend over the lap area from both extremities of the lap and fixed at two points (Fig. 1). These are generally non-retracting type (static).

3.1.2 Three Point Belt — A belt which passes diagonally across the front of the chest from the hip to the opposite shoulder and intended to constrain the lap of the wearer and upper body and constructed so that a continuous belt is fixed to a fitting at its one end and its other end, after passing over the passenger's shoulder and then across his chest, extends over his lap area after passing through slip guide and finally terminated at the fitting and supported at three points (Fig. 2). These belts may be retracting type (Inertia) or non-retracting type (static).

3.1.3 Harness Belt — A belt which is essentially a combination of lap strap and diagonal strap across the shoulder and chest (Fig. 3).

3.2 Strap/Webbing — A flexible component designed to hold the body and transmit stresses to the belt anchorages.

3.3 Buckle — A quick release device enabling the wearer to be held by the belt. The buckle head and anchor point may be connected by any of the following four ways:

- a) a flexible load bearing element, for example, cable;
- b) a webbing;
- c) a load bearing steel plate; and
- d) any other element which is capable of bearing the load.

3.4 Belt Adjusting Device — A device enabling the belt to be adjusted to the requirement of the individual wearer and to the position of the seat. The adjusting device may be part of the buckle or a retractor or any other part of the safety belt.

3.5 Attachments — Parts of the belt assembly including the necessary securing components, which enable it to be attached to the belt anchorages.

3.6 Energy Absorber — A device designed to disperse energy independently or jointly with the strap and forming part of a belt assembly.

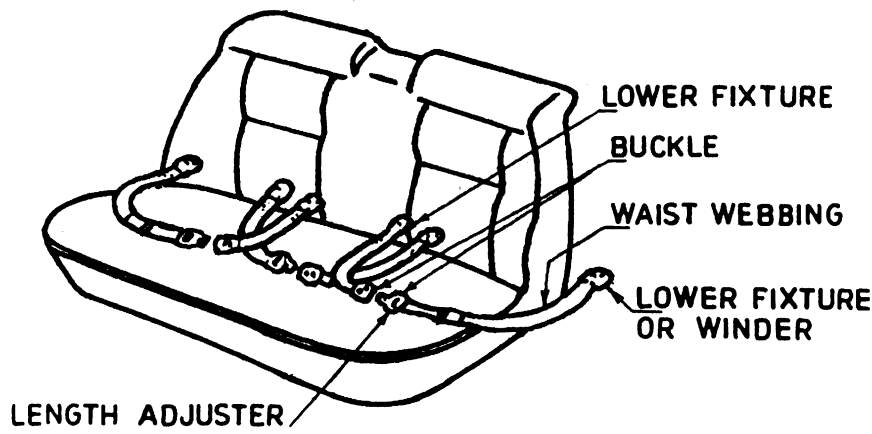


FIG. 1 TWO POINT TYPE SEAT BELT ASSEMBLY

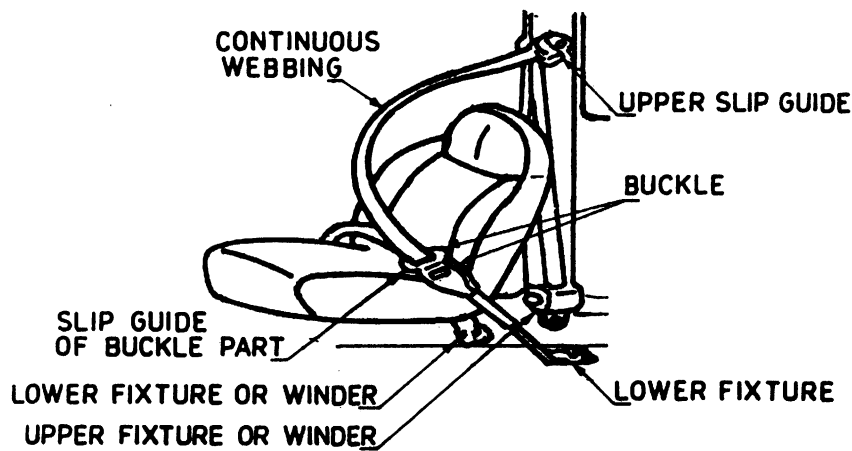


FIG. 2 THREE POINT TYPE SEAT BELT ASSEMBLY

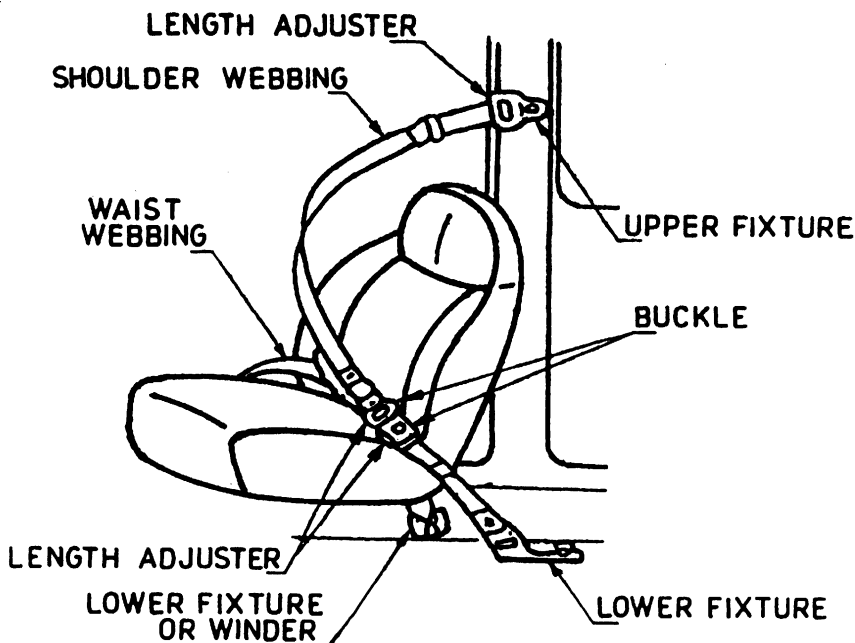


FIG. 3 HARNESS TYPE SEAT BELT ASSEMBLY

3.7 Retractor — A device to accommodate part or the whole of the strap of a safety belt.

3.7.1 Non-locking Retractor (Type 1) — A retractor from which the strap is extracted to its full length by a small external force and which provides no adjustment for the length of the extracted strap.

3.7.2 Manually Unlocking Retractor (Type 2) — A retractor requiring manual operation of a device by the user to unlock the retractor in order to obtain the desired strap extraction which locks automatically when the operation ceases.

3.7.3 Automatically Locking Retractor (Type 3) — A retractor allowing the extraction of the strap to the desired length and when the buckle is fastened, automatically adjusts the strap to the wearer. Further extraction of the strap is prevented without deliberate action by the wearer.

3.7.4 Emergency Locking Retractor (ELR) (Type 4) — A retractor which during normal driving conditions does not restrict the freedom of movement by the wearer of the safety belt. It has a length adjusting capability which automatically adjust the strap to the wearer and a locking mechanism actuated in an emergency by:

- a) Deceleration of the vehicle (single sensitivity);
- b) a combination of deceleration of the vehicle, movement of the webbing or any other automatic means (multiple sensitivity); and
- c) ELRs may be of simple locking or webbing clamp type.

3.7.5 Emergency Locking Retractor with Higher Response Threshold (Type 4 N) — A retractor of the type defined in 3.7.4 but having special properties for use in vehicles of categories M2, M3, N1, N2 and N3 as defined in 14272 (Part 1).

3.7.6 Belt Adjustment Device for Height — A device enabling the position in height of the upper pillar loop of a belt to be adjusted according to the requirements of the individual wearer and the position of the seat. It may be considered as a part of the belt or the anchorage of the belt.

3.8 Belt Anchorage — Parts of the vehicle or seat structure or any other part of the vehicle to which the safety belt assembly is to be secured.

3.9 Vehicle Type as Regards Safety Belts and Restraint Systems — The category of motor vehicles

which do not differ in parameters such as dimensions, geometry and materials of the components of the vehicle or seat structure or any other part of the vehicle to which safety belts and restraint systems are attached.

3.10 Restraint System — The system consisting of seat affixed to the structure of the vehicle by appropriate means and a safety belt for which at least one anchorage is located on the seat structure.

3.11 Seat — A structure which may or may not be integral with the vehicle structure complete with trim, intended to seat one adult person. The term covers both an individual seat or part of bench seat intended to seat one person.

3.11.1 Front Passenger Seat — The seat where the H Point measured in the foremost position of the seating position is in or in-front-of the vertical transverse plane through the R Point of the driver.

3.12 Group of Seats — A bench type seat or seats which are separable but side-by-side and seat one or more adults.

3.13 Bench Seat — A structure complete with trim, intended to seat at least two adults.

3.14 Adjustment System of the Seat — A device by which the seat or its parts can be adjusted to a position suited to the morphology of the seated occupant. This device may in particular allow:

- a) Longitudinal displacement.
- b) Vertical displacement.
- c) Angular displacement.

3.15 Seat Anchorage — The system by which the seat belt assembly is secured to the vehicle structure.

3.16 Seat Type — A category of seats which do not differ in such as:

- The structure, shape, dimensions and materials of the seat.
- The type and dimensions of the adjustment system and locking systems.
- The type and dimensions of the belt anchorages on the seat, the seat anchorage and the affected parts of the vehicle structure.

3.17 Displacement System of the Seat — A device enabling the seat or one of its parts to be displaced angularly or longitudinally without a fixed intermediate position to facilitate passenger access.

3.18 Locking System of the Seat — A device ensuring that the seat and its parts are maintained in any position of use.

3.19 Reference Zone — The space between two

vehicle longitudinal planes, 400 mm apart and symmetrical with reference to the H Point and defined by the rotation of the apparatus described in 3.27 of IS 15139 from vertical to horizontal. The apparatus shall be positioned as described in the above standard and set to a maximum limit of 840 mm.

3.20 Pre-Loading Device — An additional or integrated device which tightens the strap in order to reduce the slack of the belt during a crash sequence.

3.21 Recessed Buckle Release Button — A device with which it is not possible to release the buckle using a sphere of 40 mm diameter.

3.22 Non-recessed Buckle Release Button — A device with which it is possible to release the buckle using a sphere of 40 mm diameter.

3.23 Belt Type — The belts of different types differing substantially from one another. The differences may be with reference to any of the following parameters such as:

- a) Rigid parts (buckle, attachments, retractors);
- b) The material, weave, dimensions of the straps. Colour variations alone will not be considered a type variation where it is demonstrated that the colour variation meets the requirements for straps;
- c) The geometry of the belt assembly except where the geometry of the seat belt anchorage is within 50 mm distance sphere of an approved configuration; and
- d) Where the length of strap on an adjustable portion of a seat belt type does not vary by more than 150 mm and/or the buckle side of a seat belt type does not vary by more than 50 mm of an approved type, the seat belt assembly shall be regarded as the same as the approved type.

4 GENERAL REQUIREMENTS

4.1 Specifications

4.1.1 The safety belt/vehicle manufacturer shall provide all the information as detailed in Annex A to the testing agency for approval of the safety belt and the restraint system.

4.1.2 The minimum requirements for safety belt and retractors for different categories of vehicles are given below.

4.1.3 The belt or the restraint system shall be so designed and constructed that when installed and properly used by an occupant, its satisfactory operation is assured and it reduces the risk of injury in the event of an accident.

<i>Vehicle Category as per IS 14272 (Part 1) : 1995</i>	<i>Front Row Outboard</i>	<i>All Other Seating Positions</i>
M1, N1 and M2<3.5 ton GVW	3 Point belt with emergency locking retractor with single/multiple sensitivity	2 Point or 3 Point belt with or without retractors
All other vehicles of M and N Category	2 Point or 3 Point belt with or without retractors	

4.1.4 The straps of the seat belt shall not be liable to assume a dangerous configuration.

4.1.5 The belt after being put on the wearer, shall either adjust automatically to fit him or be such that the manual adjustment device shall be readily accessible to the seated wearer, convenient and easy to use.

4.2 Belt Components Incorporating Rigid Parts

4.2.1 General

4.2.1.1 The rigid parts of the safety belt, such as buckles, adjusting devices, attachments, etc, shall not have sharp edges liable to cause wear or breakage of the straps by chafing.

4.2.1.2 All parts of the belt assembly affected by corrosion shall be protected against it. After the corrosion test prescribed in 5.1, neither signs of deterioration likely to impair the proper functioning of the device nor any significant base metal corrosion shall be visible to the unaided eye.

4.2.1.3 Rigid parts intended to absorb energy or to be subjected to or transmit load shall not be fragile.

4.2.1.4 The rigid items and plastic parts of a safety belt shall be so located and installed that, they are not liable to become trapped under a moveable seat or in a door of that vehicle in their daily use. If any of these items and parts do not comply with the above conditions, they shall be subjected to the test specified in 5.2.4. After the test, the part shall have no disassociation nor fragmentation and shall function properly. If any visible cracks are present in any plastic cover or retainer of rigid item, the complete plastic part shall then be removed and the remaining assembly shall then be checked for its continued security. If the remaining assembly is still secure, or no visible cracks are present, it will then be further checked against the test requirements specified in 4.2.2, 4.2.3 and 4.4.2.

4.2.2 Buckle

4.2.2.1 The buckle shall be so designed as to be easy to use and preclude any possibility of incorrect use. The buckle shall not have any partial latch position. The procedure for opening the buckle shall be evident. The parts of the buckle in contact with the body of the wearer shall present a section of not less than 20 cm²

and 46 mm minimum in width, measured in a plane situated at a maximum distance of 2.5 mm from the contact surface. In the case of harness belt buckles, the latter requirement shall be regarded as satisfied if the contact area of the buckle with the body of the wearer is between 20 cm² and 40 cm².

4.2.2.2 The buckle when not under tension, shall remain closed whatever be its position. It shall not be possible to release the buckle inadvertently, accidentally or with a force of less than 10 N. When it is not under tension and when under a maximum load of 300 N, it shall be capable of being released by the wearer with a single simple movement of one hand in one direction. The buckle shall be released by pressing a button. For the buckles with recessed-release button, the surface to which the force is applied shall have an area of not less than 4.5 cm² and a width of not less than 15 mm with the button in the release position and when projected into a plane perpendicular to the button initial direction of motion. For non-recessed devices, the area shall not be less than 2.5 cm² and a width of not less than 10 mm. The buckle release area shall be coloured red. No other externally visible parts of the buckle shall be of this colour. Direction/mode of operation 'PRESS/PUSH/LIFT' shall be indicated on the buckle.

4.2.2.3 The buckle shall be capable of withstanding repeated operation and shall operate on 5 000 opening and closing cycles under normal conditions of use prior to dynamic test as per 5.5.2. In the case of harness belt buckles, the test may be carried out without all the tongues being introduced.

4.2.2.4 The buckle, when tested in accordance with 5.2.3, shall operate normally.

4.2.2.5 The buckle shall be tested for strength as prescribed in 5.2.1 and 5.2.5. It shall not break or distorted or become detached when subjected to the prescribed load.

4.2.2.6 The force required to open the buckle in the test as prescribed in 5.5.3 shall not exceed 60 N for button type buckle and 140 N for the lever type buckle of a two point or three point safety belt assembly.

4.2.2.7 In the case of buckles having a component common to the two assemblies, if the buckle of one

assembly can be assembled in use with the mating part of that assembly with that of other assembly, the strength and release test as per 5.5.2 and 5.5.3 shall also be carried out for both possible means of assembly.

4.2.3 Belt Adjustment Device

4.2.3.1 Two samples of each belt adjustment device shall be tested in accordance with the requirement of 5.2.8. The strap slip shall not exceed 25 mm for each sample of adjusting device and the sum of shifts for all the adjusting devices shall not exceed 40 mm.

4.2.3.2 All the adjustment devices shall be tested for strength as prescribed in 5.2.1 and 5.2.5. They shall not break or become detached under the tension set up by the prescribed load.

4.2.3.3 When tested in accordance with 5.2.6, the force required to operate any manually adjusting device shall not exceed 50 N.

4.2.4 Attachments and Belt Adjustment Devices for Height

The attachments shall be tested for strength as prescribed in 5.2.1 and 5.2.2. Belt adjustment devices for height shall be tested for strength as prescribed in 5.2.2, unless they have been tested as part of the vehicle anchorage systems as per IS 15139.

These parts shall not break or become detached under the tension set up by the prescribed load.

4.2.5 Retractors

Retractors, other than non-loading ones, shall be subjected to tests and fulfil the requirements specified below, including the tests for strength prescribed in 5.2.1 and 5.2.2.

4.2.5.1 Manually unlocking retractors

- a) The strap of a safety belt assembly equipped with a manually unlocking retractor shall not move more than 25 mm between the locking positions of the retractor.
- b) The strap of a safety belt assembly shall extract from a manually unlocking retractor within 6 mm of its maximum length when a tension between 14 N and 22 N is applied to the strap in the normal direction of pull.
- c) The strap shall be withdrawn from the retractor and allowed to retract repeatedly as described in 5.3.1 until 5 000 cycles have been completed. The retractor shall then be subjected to the corrosion test given in 5.1 and the dust resistance test given in 5.3.3. It shall satisfactorily complete a further 5 000 cycles of withdrawal and retraction and still meet the requirement of (a) and (b) above.

4.2.5.2 Automatically locking retractors

- a) The strap of a safety belt assembly equipped with an automatically locking retractor shall not move more than 30 mm between the locking positions of the retractor. After a rearward movement by the wearer, the belt must either remain at its initial position or return to that position automatically on subsequent forward movements of the wearer.
- b) If the retractor is part of a lap belt, the retracting force of the strap shall not be less than 7 N when measured in the free length between the manikin and the retractor in accordance with 5.3.4. If the retractor is part of an upper torso restraint, the retracting force of the strap shall be between 2 N and 7 N when measured. If the strap passes through a guide or pulley, the retracting force shall be measured in the free length between the manikin and guide or pulley. If the assembly incorporates a device which upon manual or automatic operation prevents the strap from being completely retracted, such a device shall not be operated when the retracting force is measured.
- c) The strap shall be withdrawn from the retractor and allowed to retract repeatedly by the method described in 5.3.1 until 5 000 cycles of withdrawal and retraction have been completed. The retractor shall then be subjected to the corrosion test given in 5.1 followed by dust resistance test prescribed in 5.3.3. It shall satisfactorily complete a further 5 000 cycles and meet the requirements of 4.2.5.2 (a) and (b).

4.2.5.3 Emergency locking retractor

- a) An emergency locking retractor, when tested in accordance with 5.3.2, shall satisfy the conditions as given below:
 - 1) The locking shall have occurred when the deceleration of the vehicle reached 0.45 g in the case of Type 4 retractors or 0.85 g in the case of Type 4 N retractors.
 - 2) It shall not lock at values of accelerations of the strap, measured in the direction of the unreeling less than 0.8 g in the case of Type 4 retractors or 1.0 g in the case of Type 4 N retractors.
 - 3) It shall not lock when the sensing device is tilted 12° or less in any direction from the installation position specified by the manufacturer.
 - 4) It shall lock when its sensing device is

tilted by more than 27° in the case of Type 4 retractors or 40° in the case of Type 4 N retractors in any direction from the installation position specified by the manufacturer.

- 5) In case of single sensitivity [3.7.4(a)], only the specifications regarding the deceleration of vehicle are valid.
- b) An emergency locking retractor with multiple sensitivity when tested according to 5.3.2, including the strap sensitivity, shall comply with the specified requirements and also lock up when the strap acceleration measured in the direction of unreeling is not less than 2 g.
- c) In each of the tests mentioned in 4.2.5.3 (a) and (b), the amount of strap movement which may occur before the retractor locks shall not exceed 50 mm starting at the length given in 5.3.2.1. In the case of the test mentioned in 4.2.5.3(a)(1) above, the locking shall not occur during the 50 mm of strap movement starting at the length given in 5.3.2.1.
- d) If the retractor is part of the lap belt it shall meet the conditions specified in 4.2.5.2(b).
- e) The strap shall be withdrawn from the retractor and allowed to retract repeatedly by the method described in 5.3.1 until 40 000 cycles have been completed. The retractor shall then be subjected to the corrosion test given at 5.1 and followed by the dust resistance test prescribed in 5.3.3. It shall satisfactorily complete a further 5 000 cycles of withdrawal and retraction and meet the requirements of 4.2.5.3 (a), (b), (c) and (d).

4.2.5.4 Pre-loading devices

- a) After subjecting to the corrosion test in accordance with 5.1, the pre-loading device shall operate normally.
- b) It shall be verified that inadvertent operation of the device does not involve any risk of bodily injury for the wearer.
- c) In the case of pyrotechnic pre-loading devices, the operation of the pre-loading device must not have been activated by the temperature and the device shall operate normally after subjected to the conditioning in accordance with 5.2.7. Precautions shall be taken to prevent the hot gases expelled from igniting adjacent flammable materials.

4.3 Straps

4.3.1 General

4.3.1.1 The characteristics of the straps shall be such

as to ensure that their pressure on the wearer body is distributed as evenly as possible over their width and do not twist under load. They shall have energy absorbing and dispersing capacities. The straps shall have finished salvages which shall not become unravelled in use.

4.3.1.2 The width of the straps under load of 10 kN shall be not less than 46 mm when measured during the breaking strength test prescribed in 5.4.1 without stopping the machine.

4.3.2 Strength After Room Conditioning

In the case of two straps samples conditioned in conformity with 5.4.2.2, the breaking load of the strap, determined as prescribed in 5.4.1, shall be not less than 22.7 kN. The difference between the breaking loads of the two samples shall not exceed 10 percent of the higher value of the breaking loads measured.

4.3.3 Strength After Special Conditioning

In the case of two straps samples conditioned in conformity with one of the provisions of 5.4.2.3 to 5.4.2.7, the breaking load of the strap shall be not less than 75 percent of average of the loads determined in the test referred to in 4.3.2.

4.3.4 Strength After Abrasion Conditioning

4.3.4.1 Samples conditioned in compliance with 5.4.2.7, the breaking strength shall be assessed as prescribed in 5.2.1 and 5.4.1. It shall be equal to 75 percent of the average of the breaking strength determined during tests on unabraded straps and not less than the minimum load specified for the item being tested. The difference between breaking loads of the two samples shall not exceed 20 percent of the highest measured breaking load. For Type 1 and Type 2 procedures, the breaking strength test shall be carried out on strap samples only according to 5.4.1. For Type 3 procedure, the breaking strength test shall be carried out on the strap in combination with the metal component involved according to 5.2.1.

4.3.4.2 The items to be subjected to the abrasion test procedure and the procedure(s) to be followed are indicated below. A new sample shall be used for each procedure:

Component/ Procedure	Type 1	Type 2	Type 3
Attachment	-	-	×
Guide or Pulley	-	×	×
Buckle Loop	-	×	×
Adjusting Device	×	-	×
Parts Sewn to the Strap	-	-	×

4.3.5 Elongation

The elongation of the webbing shall be 20 percent or less when the webbing is tested by the method specified in 5.4.3.

4.3.6 Energy Absorptivity

The work and work load ratio shall not be less than the values mentioned below when the webbing is tested by the method specified in 5.4.4:

Type of Webbing	Work/Length Nm/m	Work Load Ratio
Lap webbing	500	50
Continuous webbing	800	55

4.4 Belt Assembly or Restraint Systems

4.4.1 Static Strength/Displacement Test (not Applicable for ELR Belt)

When tested in accordance with the provisions of 5.5.1, the seat belt shall sustain the maximum test load for the type of assembly for a minimum continuous period of 30 s. The test load shall then be reduced to a force of 665 ± 50 N and the buckle opening force as per 5.5.3 shall not exceed 60 N for button type buckle and 140 N for the lever type buckle of a two point or three point seat belt assembly.

4.4.1.1 The displacement shall be measured after the test load has been applied for a minimum continuous period of 30 s according to 5.5.1 and this shall not be more than 180 mm for two point and 250 mm for three point safety belt assemblies.

4.4.1.2 This requirement is not applicable if the dynamic test requirement as per 4.4.2 is met.

4.4.2 Dynamic Test

4.4.2.1 The belt assembly or restraint system shall be subjected to a dynamic test in conformity with 5.5.2.

4.4.2.2 The dynamic test shall be performed on two assemblies which have not been earlier under load.

4.4.2.3 The buckles of the belt assemblies to be tested shall have met the requirements of 4.2.2.3. In the case of safety belts with retractors, the retractor shall have been subjected to the dust resistance test (5.3.3).

4.4.2.4 In addition, in case of safety belts/restraint system equipped with a pre-loading device comprising pyrotechnic means, the device shall have been subjected to the conditioning specified in 5.2.7.

4.4.2.5 The belts shall be subjected to the corrosion test prescribed in 5.1 after which the buckle shall be subjected to 500 additional opening and closing cycles under normal conditions of use.

4.4.2.6 Safety belts with retractors shall have been subjected to the tests as per 4.2.5.1 or 4.2.5.2 or 4.2.5.3 but not required if retractor had already passed the corrosion test.

4.4.2.7 In the case of a belt intended for use with a belt adjustment device for height, the test shall be carried out with the device adjusted in the most unfavourable position(s). However if the belt adjustment device for height consists of belt anchorage itself, provision of 5.5.2.1 may apply.

4.4.2.8 In the case of a safety belt with preloading device, one of the dynamic tests shall be carried out with the device in operation and the other with the device not in use. In the first case, the minimum displacements as given in 4.4.2.9(b) may be reduced to half.

4.4.2.9 During this test, the following requirements shall be met:

- No part of the belt assembly or a restraint system affecting the restraint of the occupant shall break and no buckles or locking system or displacement system shall release or unlock; and
- The forward displacement of the manikin shall be between 80 mm and 200 mm at pelvic level in the case of lap belts. In the case of harness belt, the minimum displacement specified for the pelvis may be reduced by half. In the case of other types of belts, the forward displacement shall be between 80 mm and 200 mm at the pelvic level and between 100 mm and 300 mm at torso level. These displacements are the displacements in relation to the measurement points shown in Fig. 25 (Annex D).

4.4.2.10 In the case of a restraint system:

- The movement of the torso reference point may exceed that specified in 4.4.2.9(b) if it can be shown either by calculation or a further test that no part of the torso or the head of the manikin used in the dynamic test would have come into contact with any forward rigid part of the vehicle other than the chest with the steering assembly, if the latter meets the requirements of IS 11939 and provided the contact does not occur at a speed higher than 24 km/h. For this assessment the seat shall be considered to be in the position specified in 5.5.2.5.
- In vehicles where such devices are used, the displacement and locking systems enabling the occupants of all seats to leave the vehicle

shall still be operable by hand after the dynamic test.

- c) The force required to open the buckle in the test as prescribed in 5.5.3 shall not exceed 60 N for button type buckle and 140 N for the lever type buckle of a two point or three point seat belt assembly.

5 TESTS

The details of number of samples to be taken and tests to be carried out for acceptance of a type of belt or restraint system shall be as given in Table 1.

5.1 Corrosion Test

5.1.1 The complete safety belt assembly shall be subjected to salt spray testing in a test chamber as prescribed in Annex B. In the case of an assembly incorporating a retractor, the strap shall be unwound to full length less 300 ± 3 mm. The test duration shall be 50 h.

5.1.2 On completion of the test, the assembly shall be washed, in a clean running water at a temperature not higher than 38°C , to remove any salt deposit that may have formed and then allowed to dry at room temperature for 24 h and checked in accordance with 4.2.1.2.

5.2 Static Test of Belt Components Incorporating Rigid Parts

5.2.1 The buckle and strap adjusting device shall be connected to a tensile-testing machine and apply a load of 10 kN. In the case of harness belts, the buckle shall be connected to the testing apparatus by the straps which are attached to the buckle and the tongue or two tongues located symmetrically to the geometric centre of the buckle. If the buckle or adjusting device is part of the attachment or of the common component of a three-point strap, the buckle or adjusting device shall be tested together with the attachment in accordance with 5.2.2 except in the case of retractors with return pulley at the upper strap anchorage. In this case the test load shall be 10 kN and the length of strap remaining on the reel at the moment of locking shall be as close as possible to 450 mm.

5.2.2 The attachments and any belt adjustment devices for height shall be tested as per 5.2.1 and the load of 15 kN shall be applied in the least favourable conditions likely to occur in a vehicle in which the belt is installed as per 5.5.2.1. In the case of retractors the test shall be performed with the strap completely unwound from the reel.

5.2.3 Two samples of the complete belt assembly shall be placed in a low-temperature chamber at $-10 \pm 1^\circ\text{C}$ for two hours. Immediately after being removed from

the chamber, the mating parts of the buckle shall then be locked together manually. The buckle shall operate normally.

5.2.4 Two samples of the complete belt assembly shall be placed in a low-temperature chamber at a temperature of $-10 \pm 1^\circ\text{C}$ for two hours. All rigid items and parts made of plastic under test shall then be laid in turn on a flat rigid steel surface (which has been kept with the samples in the low temperature chamber), placed on the horizontal surface of a compact rigid block with a mass of at least 100 kg, within 30 s of their being removed from the low-temperature chamber. An 18 kg steel mass shall be allowed to fall under gravity from a height of 300 mm on to the test sample. The impact force of the 18 kg mass shall take the form of convex surface with a hardness of 45 HRC minimum having a transverse radius of 10 mm and a longitudinal radius of 150 mm placed along the centre line of the mass. One sample shall be tested with the axis of the curved bar in line with the strap and the other sample shall be tested at 90° to the strap.

5.2.5 Buckles having parts common to two safety belts shall be loaded in such a way as to simulate the conditions of use in a vehicle with the seats in the mid-position of their adjustment. The direction of application of the load shall be established in accordance with 5.5.2.1. A load of 15 kN shall be applied simultaneously to each of the straps. A suitable apparatus for the above test is shown in Fig. 4.

5.2.6 When testing any manual adjusting device, the strap shall be drawn steadily through that device, having regard to normal conditions of use, at a rate of 100 mm/s, and the maximum force shall be measured to the nearest 1 N after the first 25 mm of strap movement. The test shall be carried out in both directions of strap travel through the adjusting device, the strap being cycled 10 times prior to measurement.

5.2.7 Additional Tests on Safety Belts with Pre-Loading Devices — Conditioning

The pre-loading device may be separated from the safety belt to be tested and kept for 24 h at a temperature of $60 \pm 5^\circ\text{C}$. The temperature shall then be raised to $100 \pm 5^\circ\text{C}$ for 2 h. Subsequently it shall be kept for 24 h at a temperature of $-30 \pm 5^\circ\text{C}$. After being removed from conditioning, the device shall warm up to ambient temperature and fitted again to the safety belt.

5.2.8 Micro Slip Test

5.2.8.1 The samples for micro slip test shall be conditioned as per 5.4.2.2. The test shall be carried out immediately after conditioning at a temperature between 15 to 30°C .

Table 1 Samples for the Type Approval Tests
(Clause 5)

Sl No.	Clause	Test	Sample																			
			Belt or Restraint System						Straps													
			1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	11	12	13
1	4.1.3, 4.1.4, 4.1.5	Inspection of Belt or Restraint System	x																			
	Belt Components Incorporating Rigid Parts																					
2	4.2.1.1, 4.2.1.3 4.2.1.4, 4.2.2.1	Inspection	x	x	x	x	x	x	x													
3	4.2.1.2, 5.1	Corrosion Resistance	x	x																		
4	4.2.1.4, 5.2.4	Low Temperature Impact Test	x	x																		
5	4.2.2.3	Durability of Buckle	x	x																		
6	4.2.2.4, 5.2.3	Low Temperature Test on Buckle	x	x																		
7	4.2.2.7, 5.2.1, 5.2.5	Buckle Strength Test			x																	
8	4.2.3.3, 5.2.6	Ease of Adjustment				x																
9	4.2.3.1, 5.2.8	Micro Slip Test				x	x															
10	4.2.3.2, 5.2.1, 5.2.2, 5.2.5	Strength Test on Adjusting Device (when necessary on retractors)			x																	
11	4.2.4, 5.2.1, 5.2.2	Strength Test on Attachments (when necessary on retractors)			x																	
	Retractors:																					
12	4.2.5.1, 4.2.5.2 4.2.5.3, 5.3	Retracting Force, Durability, Corrosion, Dust	x	x																		
	Seat Belt Assembly																					
13	4.4.2, 5.5.2, 5.5.3	Dynamic Test	x	x																		
14	4.4.1, 5.5.1, 5.5.3	Static Strength/ Displacement Test							x	x												
15	4.3.4, 5.4.2.7	Abrasion Test				x	x															
	Straps:																					
16	4.3.1.2, 5.4.1	Testing of Strap Width								x	x											
	Strap Strength After (5.5.1)																					
17	4.3.2, 5.4.2.2	Room Conditioning								x	x											
18	4.3.3, 5.4.2.3	Light Conditioning										x	x									
19	4.3.3, 5.4.2.4	Low Temperature Conditioning												x	x							
20	4.3.3, 5.4.2.5	Heat Conditioning														x	x					
21	4.3.3, 5.4.2.6	Water Conditioning																x	x			
22	4.3.5, 4.3.6, 5.4.3, 5.4.4	Elongation and Energy Absorptivity																		x	x	
23	----	Retention of Strap Sample																				x

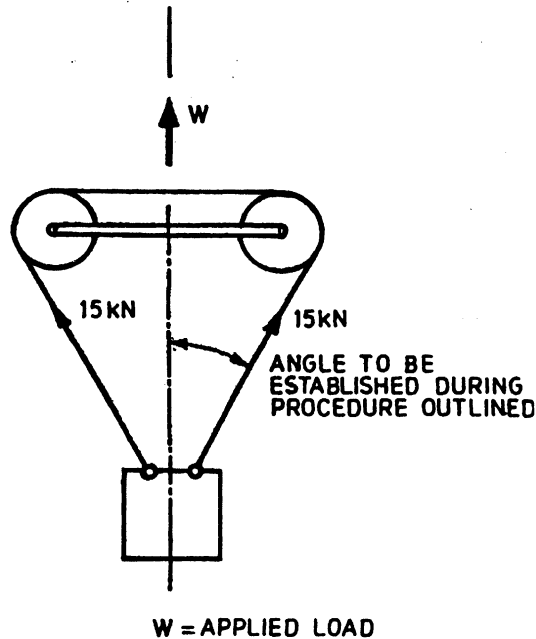


FIG. 4 BUCKLE STRENGTH TEST

5.2.8.2 It shall be ensured that the free section of the adjusting device points either up or down on the test bench, as in the vehicle.

5.2.8.3 A 50 N load shall be attached to the lower end of the section of strap. The other end shall be subjected to a back and forth motion, the total amplitude being 300 ± 20 mm.

5.2.8.4 If there is a free end serving as a reserve strap, it shall in no way be fastened or clipped to the section under load.

5.2.8.5 It shall be ensured that on the test bench, the strap, in the slack position, descends in a concave curve from the adjusting device, as in the vehicle. The 50 N load applied on the test bench shall be guided vertically in such a way as to prevent the load swaying and the belt twisting. The attachment shall be fixed to the 50 N load as in the vehicle.

5.2.8.6 Before the actual start of the test, a series of 20 cycles shall be completed so that the self tightening system settles properly.

5.2.8.7 One thousand cycles shall be completed at a frequency of 0.5 cycles per second, the total amplitude being 300 ± 20 mm. The 50 N load shall be applied only during the time corresponding to a shift of

100 ± 20 mm for each half period.

5.3 Tests for Retractors

5.3.1 Durability of Retractor Mechanism

The strap shall be withdrawn and allowed to retract for the required number of cycles at a rate of not more than 30 cycles/min. In the case of emergency locking retractors, a snatch to lock the retractor shall be introduced at each fifth cycle. The snatches shall occur in equal numbers at each of five different extractions, namely, 90, 80, 75, 70 and 65 percent of the total length of the strap remaining wound on the retractor. However, where more than 900 mm is provided, the above percentages shall be related to the final 900 mm of strap which can be withdrawn from the retractor. A suitable apparatus is shown in Fig. 5.

5.3.2 Locking of Emergency Locking Retractors

5.3.2.1 The retractor shall be tested once for locking when 300 ± 3 mm of the strap remain wound on the retractor reel.

5.3.2.2 In the case of the retractor actuated by strap movement, the extraction shall be in the direction in which it normally occurs when the retractor is installed in a vehicle.

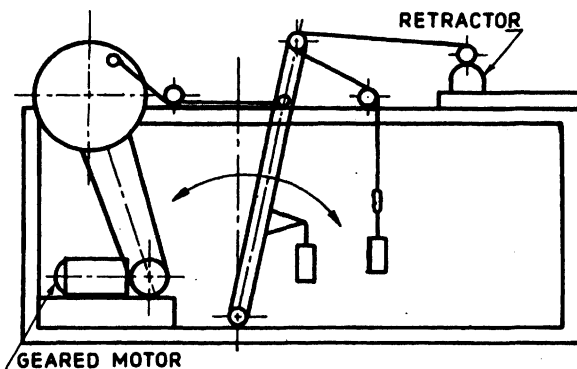


FIG. 5 TYPICAL APPARATUS TO TEST DURABILITY OF RETRACTOR MECHANISM

5.3.2.3 When retractors are being tested for sensitivity to vehicle deceleration they shall be tested at the above extraction along two mutually perpendicular axes, which are horizontal if the retractor is installed in a vehicle as specified by the safety belt manufacturers. One of these axes shall be in the direction chosen by the test agency to give the most adverse conditions with respect to actuation of the locking mechanism.

5.3.2.4 A suitable apparatus for the tests is shown in Annex C. The design of which ensure that the required acceleration is given before the webbing is withdrawn out of the retractor by more than 5 mm and that the withdrawal takes place at an average rate of increase of acceleration is between 25 and 150 g/s.

5.3.2.5 To check conformity with the requirements of 4.2.5.3 (a) (3) and (4), the retractor shall be mounted on a horizontal table tilted with a speed not exceeding 2°/s until locking has occurred. The test shall be repeated with tilting in other directions to ensure that the requirements are fulfilled.

5.3.3 Dust Resistance

5.3.3.1 The retractor shall be positioned in a test chamber as described in Fig. 6. It shall be mounted with the same relative position as in the vehicle. The test chamber shall contain dust as specified in 5.3.3.2. A length of 500 mm of the strap shall be extracted from the retractor and kept extracted, except that it shall be subjected to ten complete cycles of retraction and withdrawal within one or two minutes after each agitation of the dust. For a period of 5 h, the dust shall be agitated every twenty minutes for five seconds by compressed air free of oil and moisture at a gauge

pressure of 550 kPa entering through an orifice 1.5 ± 0.1 mm in diameter.

5.3.3.2 The dust used in the test prescribed in 5.3.3.1 shall consist of about 1 kg of dry quartz of particle size distribution as follows:

	Percent
a) Passing 150 microns aperture, 10 microns wire diameter	99-100
b) Passing 105 microns aperture, 64 microns wire diameter	76-86
c) Passing 75 microns aperture, 52 microns wire diameter	60-70

5.3.4 Retracting Force (see Fig. 7)

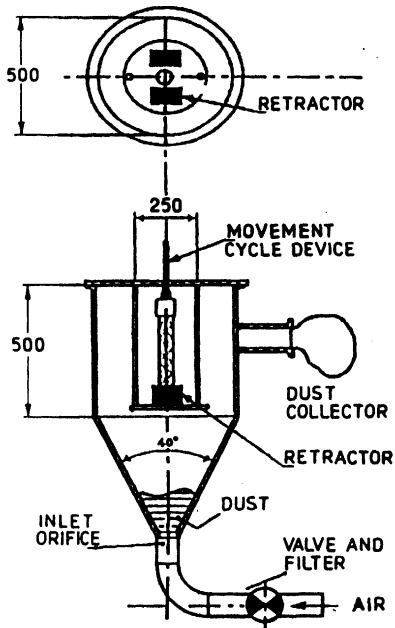
The retracting force shall be measured with the safety belt assembly fitted to a manikin as per the dynamic test prescribed in 5.5.2. The strap tension shall be measured at the point of contact with the manikin while the strap is being retracted at rate of 0.6 m/min.

5.4 Tests on Straps

5.4.1 Breaking Strength of Strap (Static Test)

5.4.1.1 The test shall be carried out each time on two new samples of strap of sufficient length, conditioned in conformity with 5.4.2.

5.4.1.2 Each strap shall be gripped between the clamps of a tensile testing machine. The clamps shall be so designed as to avoid breakage of the strap at or near the point of contact with the clamps. The speed of traverse shall be about 100 mm/min. The free length of the specimen between the clamps of the machine at



All dimensions in millimetres.
FIG. 6 TYPICAL APPARATUS FOR TESTING THE DUST RESISTANCE OF RETRACTORS

the start of the test shall be 200 ± 40 mm. A recommended arrangement for gripping the strap in tensile testing machine is shown in Fig. 8.

5.4.1.3 When the load reaches 10 kN, the width of the strap shall be measured without stopping the machine.

5.4.1.4 The tension shall be increased until the strap breaks and the breaking load is noted.

5.4.1.5 If the strap slips or breaks at the point of contact or within 10 mm of either of the clamps, the test shall be invalid and a new test shall be carried out on another specimen.

5.4.2 Conditioning of Straps

5.4.2.1 Samples cut from the strap given for testing shall be conditioned:

- at room conditions as per 5.4.2.2; and
- at special conditions as per 5.4.2.3 to 5.4.2.7.

5.4.2.2 *Room conditioning* — The strap shall be kept for at least 24 h in an atmosphere having temperature of $20 \pm 5^\circ\text{C}$ and a relative humidity of 65 ± 5 percent. If the test is not carried out immediately after conditioning, the specimen shall be replaced in a hermetically closed receptacle until the test begins. The breaking load shall be determined within five minutes after removal of the strap from the conditioning atmosphere or from the receptacle.

5.4.2.3 *Light conditioning* — The provision of recommendations of ISO 4582 shall apply. The strap shall be exposed to light for the time necessary to produce a contrast equal to Grade 4 on the grey scale on Standard Blue Dye No. 7. After exposure the strap shall be conditioned and tested for breaking load as per 5.4.2.2.

5.4.2.4 *Cold conditioning* — The strap shall be conditioned according to 5.4.2.2. Then the strap shall be kept for 1.5 h on a plane surface in a low temperature chamber in which the air temperature is kept at $-30 \pm 5^\circ\text{C}$ and kept under load for 30 min in the same low temperature chamber. Then the mass

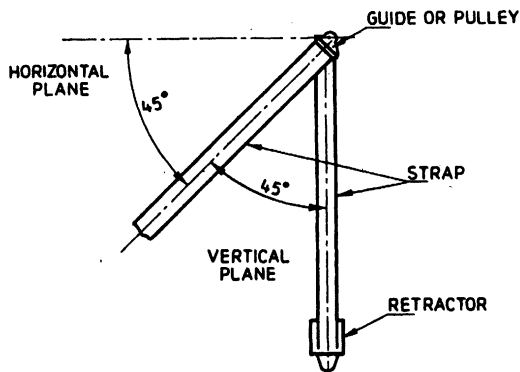


FIG. 7 RETRACTION FORCE MEASUREMENT

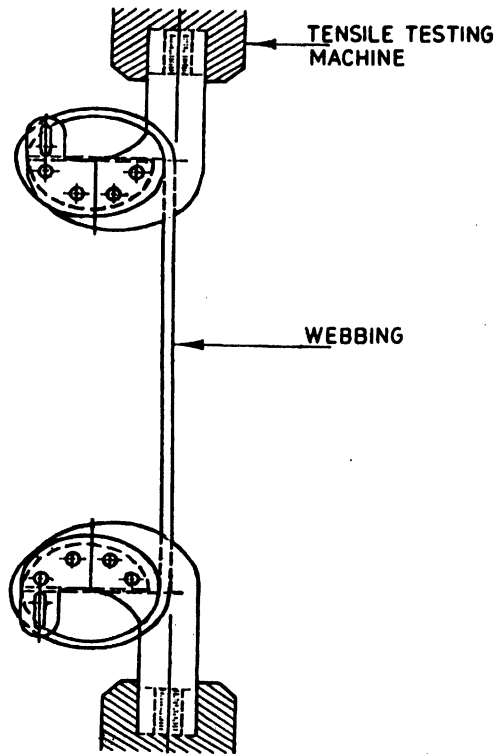


FIG. 8 TYPICAL SETUP FOR GRIPPING THE STRAP IN TENSILE TESTING MACHINE

shall be removed and the breaking load shall be measured within five minutes after removal of the strap from the low temperature chamber.

5.4.2.5 Heat conditioning — The strap shall be kept for 3 h in a heating cabinet in an atmosphere having a temperature of $60 \pm 5^\circ\text{C}$ at a relative humidity of 65 ± 5 percent. The breaking load shall be determined within five minutes after removal of the strap from the heating cabinet.

5.4.2.6 Exposure to water — The strap shall be kept fully immersed for 3 h in distilled water, at a temperature of $20 \pm 5^\circ\text{C}$, to which a trace of wetting agent has been added. Any wetting agent suitable for the fibre under the test may be used. The breaking load shall be determined within 10 min after removal of the strap from the water.

5.4.2.7 Abrasion conditioning

5.4.2.7.1 The abrasion conditions will be performed on each and every device in which the strap is in

contact with a rigid part of the belt. However, Type 1 abrasion test need not be carried out on the belt adjusting device where the micro slip test as per 5.2.8 shows the strap slip less than half the specified amount. The setting on the test apparatus will approximately maintain the relative position of the strap and contact area. The samples shall be conditioned as per 5.4.2.2. The ambient temperature during the abrasion procedure shall be between 15 and 30°C .

5.4.2.7.2 The requirements for each abrasion procedure are listed below. The shift given in the last column of this table represents the amplitude of a back and forth motion applied to the strap:

Procedure	Load, N	Frequency Hz	No. of Cycles	Shift mm
Type 1	25	0.5	5 000	300 ± 20
Type 2	5	0.5	45 000	300 ± 20
Type 3	5	0.5	45 000	—

5.4.2.7.3 Details of procedures

a) Type 1

This procedure is for cases where the strap slides through an adjusting device. A vertical steady load of 25 N shall be maintained on one end of the strap, the other end of the strap shall be attached to a device giving the strap a horizontal back and forth motion. The adjusting device shall be placed on the horizontal strap so that the strap remains under load as shown in Fig. 9. In the cases where the strap does not slide back and forth with 25 N load, the load may be increased up to 50 N to allow a back and forth motion.

b) Type 2

This is for cases where the strap changes direction once in passing through a rigid part. During this test, the angles which both strap ends make with each other shall be maintained as shown in Fig. 10. A steady load of 5 N shall be maintained during the test. If the strap changes direction more than once in passing through a rigid part, the load of 5 N may be increased so as to achieve the prescribed strap movement of 300 mm through that rigid part.

c) Type 3

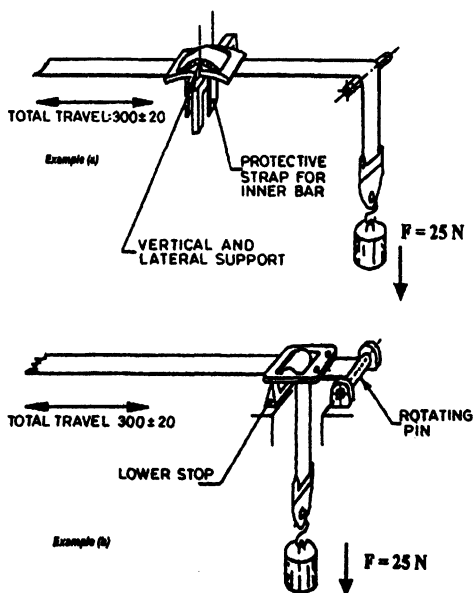
This is for cases where the strap is fixed to a rigid part of sewing or similar means. The total back and forth motion that is, shift shall be 300 ± 20 mm and the 50 N load shall only be applied during the time corresponding to a shift of 100 ± 20 mm for each half period as shown in Fig. 11.

5.4.3 Elongation Test

A test piece shall be fixed on the tensile testing machine in the method described in 5.4.1.2 and apply an initial load of 200 N, to strain the test piece with the clamps kept 200 ± 20 mm apart. Gauge marks of 200 mm distance within the clamp distance shall be marked. The tension load shall be applied at a rate of approximately 100 mm/min. When the load reaches 11.1 kN, the distance between the gauge marks should be measured and percentage elongation shall be calculated.

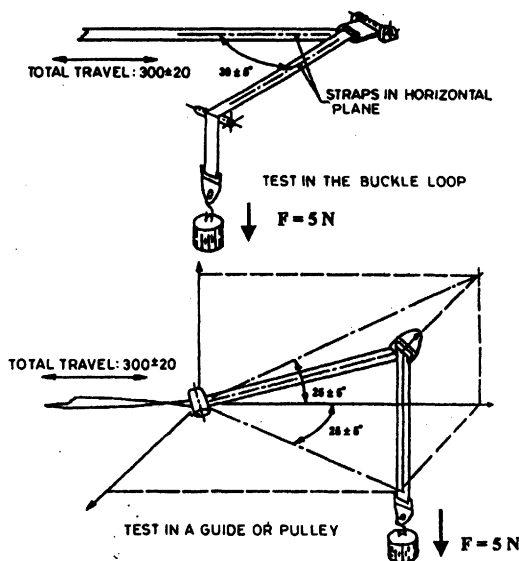
5.4.4 Energy Absorptivity Test

A tension load up to 11.1 kN shall be applied at an approximate rate of 100 mm/min on the test piece by the method specified in 5.4.1.2 and then decreased to the initial load of 200 N at the same rate. The load/elongation diagram shall be drawn (see Fig. 12). The



All dimensions in millimetres.

FIG. 9 TYPE 1 — PROCEDURE TEST EXAMPLE OF TEST ARRANGEMENTS CORRESPONDING TO THE TYPE OF ADJUSTING DEVICE



All dimensions in millimetres.

FIG. 10 TYPE 2 — PROCEDURE TEST

work load per unit elongation is obtained by dividing the work load area (ABD) produced by the tension load curve from the time of the initial load to that of the final load. The work load area (ABC) enclosed by the curve AB at the time of the tension and the curve BC at the time of removal are to be measured. The work load ratio representing the energy absorptivity is obtained from the following formula

$$\text{Work Load Ratio} = \text{ABC/ABD} \times 100 \text{ percent}$$

5.5 Tests on Seat Belt Assemblies

5.5.1 Static Strength/Displacement Test of Seat Belt Assembly/Restraint Systems

5.5.1.1 The assembly shall be conditioned for room conditions as per 5.4.2.2.

5.5.1.2 The test apparatus consists of two rollers of 100 mm dia, with its centre kept 300 mm apart and supported by roller bearings. The load is applied centrally to the rollers by a suitable loading block at the rate of 100 mm/min. The belt assembly may be fixed in the same way as it is in the vehicle using the same fitments and bolts.

5.5.1.3 For seat belt equipped with non-locking retractor, the test shall be carried out with the fully extended condition of the webbing. For those equipped with automatic/emergency locking retractors, the test shall be made in the condition where the locking mechanism functions.

5.5.1.4 Two point type (see Fig. 13)

The test assembly shall be mounted on to the testing apparatus with its loop length about 1 300 mm. In case the length is less than 1 300 mm, the test may be carried out with the longest possible length. A tension load from 200 N to 22.7 kN may be applied at the specified rate. The component and its parts shall be examined for any abnormalities and the vertical displacement of the rollers during the loading, that is, between 200 N and 22.7 kN.

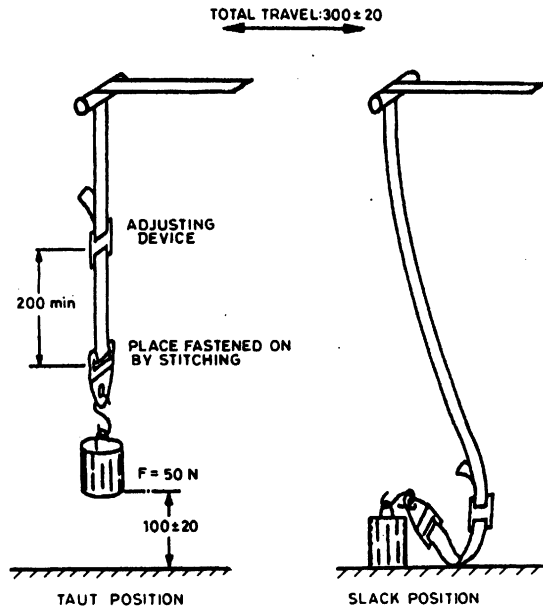
5.5.1.5 Three point type

The test is carried out in the same way as the two point belt as per Fig. 14.

5.5.1.6 The buckle opening test shall be continued with a load of 665 ± 50 N on the assembly in accordance with 5.5.3.

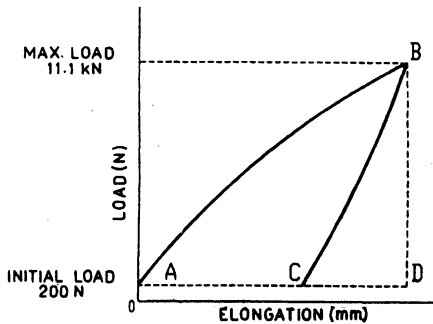
5.5.2 Dynamic Test of Belt Assembly

5.5.2.1 The belt assembly shall be mounted on a trolley equipped with the seat and the anchorages defined in Annex D (see Fig. 15). However, if the belt assembly is intended for a specific vehicle or for specific types of vehicle, the distances between the manikin and the anchorages shall be determined, either in conformity with the fitting instructions supplied with the belt or in conformity with the data supplied by the manufacturer of the vehicle. In that case, when the dynamic test has been carried out for a type of vehicle, it need



All dimensions in millimetres.

FIG. 11 ABRASIONS AND MICRO SLIP TEST



$$\text{WORK LOAD RATIO} = \frac{ABC}{ABD} \times 100 \text{ percent}$$

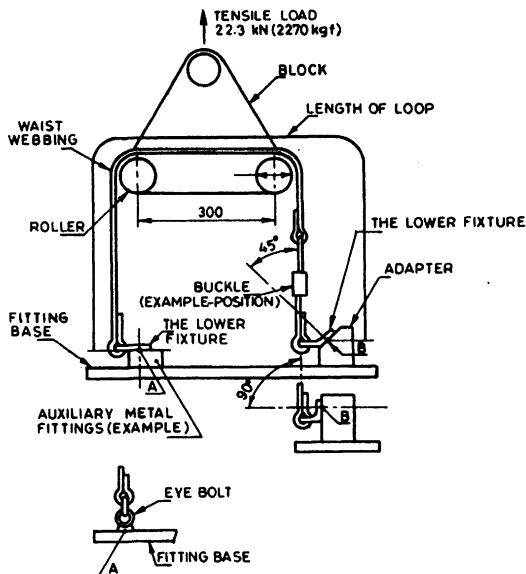
FIG. 12 ENERGY ABSORPTIVITY GRAPH

not be repeated for other types of vehicles where each anchorage point is less than 50 mm distant from the corresponding anchorage point of the tested belt. Alternatively, manufacturers may determine hypothetical anchorage positions for testing in order

to enclose the maximum number of real anchorages points. If the belt is equipped with a belt adjustment device for height, the position of the device and its means of securing shall be the same as those of the vehicle design.

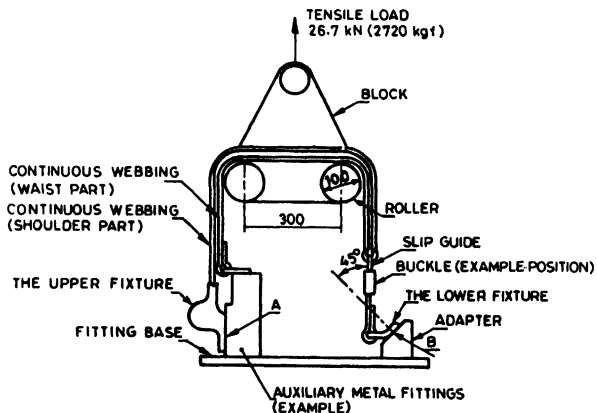
5.5.2.2 In the case of a safety belt or restraint system forming part of an assembly for which approval is requested as a restraint system, the safety belt shall be mounted on the part of the vehicle structure to which the restraint system is normally fitted and this part shall be rigidly attached to the trolley as given in 5.5.2.3.

5.5.2.3 The method used to secure the vehicle during the test shall not be such as to strengthen the anchorage of the seats or safety belts or to lessen the normal deformation of the structure. No forward movement of the vehicle shall be present which by limiting the forward movement of the manikin except the foot, would reduce the load imposed on the restraint system during the test. The discarded part of the structure can be replaced by parts of equivalent strength provided they do not hinder the forward movement of the manikin.



All dimensions in millimetres.

FIG. 13 STATIC STRENGTH/DISPLACEMENT OF SEAT BELT ASSEMBLY/RESTRAINT SYSTEM SETUP FOR TWO POINT TYPE



All dimensions in millimetres.

FIG. 14 STATIC STRENGTH/DISPLACEMENT OF SEAT BELT ASSEMBLY/RESTRAINT SYSTEM SETUP FOR THREE POINT TYPE

5.5.2.4 A securing device can be considered satisfactory if it produces no effect on the area extending over the entire width of the structure and if the vehicle or the structure is blocked or fixed at a distance of not less than 500 mm from the anchorage of the restraint system. At the rear, the structure shall be secured at a sufficient distance behind the anchorage to ensure that the requirements of the **5.5.2.3** are complied.

5.5.2.5 The seats shall be adjusted and placed in the position for driving use chosen by Inspection agency for adverse conditions with respect to strength, consistent with the positioning of the manikin in the vehicle. The positions of the seat shall be stated in the report. If the seat back is adjustable, it shall be locked as specified by the manufacturer or, in the absence of any specification, to an actual seat back angle as near as possible to 25° in the case of vehicles of categories M1 and N1 and as near as possible to 15° in the case of vehicles of all other categories.

5.5.2.6 For the assessment of the requirements in **4.4.2.10(a)**, the seat shall be regarded as being in its most forward driving or travelling position appropriate to the dimensions of the manikin.

5.5.2.7 All the seats of the same group shall be tested simultaneously.

5.5.2.8 The seat belt assembly shall be attached to the manikin as described in **D-5** and Fig. 15. A board 25 mm thick shall be placed between the back of the manikin and the seat back. The belt shall be fastened around the manikin. The board shall then be removed so that the whole length of its back is in contact with the seat back. A check shall be made to ensure that the mode of engagement of the two parts of the buckle entails no risk of reducing the reliability of locking.

5.5.2.9 The free ends of the straps shall extend beyond the adjusting devices to allow for slip.

5.5.2.10 The trolley shall then be so propelled that at the moment of impact, its free running speed is 50 ± 1 km/h and the manikin remains stable. The stopping distance of the trolley shall be 400 ± 50 mm. The trolley shall remain horizontal throughout deceleration. The deceleration of the trolley shall be achieved by using the apparatus using deformable plastic tubes or any other device giving equivalent results. This apparatus shall comply with the performance specified in **D-4.6.1** (see Fig. 19).

5.5.2.11 The trolley speed immediately before impact and the maximum forward displacement of the manikin shall be measured.

5.5.2.12 After impact, the belt assembly or restraint system and its rigid parts shall be inspected visually,

without opening the buckle, to determine whether there has been any failure or breakage. In the case of restraint systems, it shall also be ascertained, after the test, whether the parts of the vehicle structure which are attached to the trolley have undergone any visible or permanent deformation. If there is any such deformation found, this shall be taken into account in any calculation made [**4.4.2.10(a)**].

5.5.2.13 The belt assembly shall be removed from the test trolley without the buckle being opened. The buckle opening test shall be carried out in accordance with **5.5.3**.

5.5.2.14 After the buckle opening test, the components of the belt assembly or of the restraint device shall be inspected and the extent of the damage sustained by the belt assembly or restraint device during the dynamic test shall be recorded in the test report.

5.5.3 Buckle Opening Test

5.5.3.1 For this test, belt assemblies or restraint devices which have already undergone the static strength/displacement test in conformity with **5.5.1** or dynamic test in accordance with **5.5.2** shall be used.

5.5.3.2 In case of samples subjected to static strength/displacement test, it is continued in accordance with **5.5.1.6**.

5.5.3.3 In case of samples subjected to dynamic test, a load shall be applied to the buckle by direct traction via the straps fixed to it so that all the straps are subjected to the force of $600n/N$, where 'n' is the number of straps linked to the buckle when it is in a locked position and its minimum is deemed to be 2. In the case where the buckle is connected to a rigid part, the load shall be applied at the same angle as the one formed by the buckle and the rigid end during the dynamic test.

5.5.3.4 The buckle opening force shall be applied to the geometric centre of the buckle release button along a fixed axis running parallel to the initial direction of motion of the button. During the application of the force needed to open the buckle, the buckle shall be held by a rigid support. The point of contact of the test equipment shall be spherical in shape of radius 2.5 ± 0.1 mm. It shall have a polished metal surface. For lift cover buckles, the buckle opening force shall be applied by a spring balance or other measuring device in a manner and direction which are normal for opening the buckle. For lever type buckles a hole of 2.5 mm dia may be drilled through the buckle tab or lever on a centre line between 3.0 and 3.3 mm from its edge and a small loop of soft wire may be used on the connecting link between the buckle tab or lever and the force measuring device. The buckle opening force shall be measured and any failure of the buckle noted.

5.5.4 Additional Test for Pre-loading Device

The pre-loading force shall be measured in less than 4s after the impact as close as possible to the contact point with the manikin on the free length of webbing between the manikin and the pre-loading device or sash guide, if any, the manikin having been replaced in its originally seated position.

5.6 Test Report

The test report shall record the results of all the tests given in 5 above and in particular the trolley speed, the maximum forward displacement of the manikin, the position of the buckle, the buckle opening force and any failure or breakage. If by virtue of 5.5.2.1, the anchorage prescribed in D-3 and Fig. 15 have not been respected, the test report shall describe how the belt assembly or the restraint system was installed and shall specify important angles and dimensions. The report shall also mention any distortion or breakage of the buckle that has occurred during the test. In the case of a restraint system, the test report shall also specify the manner of attaching the vehicle structure to the trolley, the position of the seats and the

inclination of the seat backs. If the forward displacement of the manikin has exceeded the values prescribed in 4.4.2.9(b), the report shall state whether the requirements in 4.4.2.10(a) are met.

6 SEAT BELT MARKING

6.1 Each seat belt assembly shall be legibly and indelibly marked with the following:

- a) Manufacturer's name or trade-mark;
- b) Part No. and means of identification; and
- c) Batch No., month and year of manufacture.

6.2 BIS Certification Marking

The seat belt may also be marked with the Standard Mark.

6.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to the manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(Clause 4.1.1)

INFORMATION TO BE PROVIDED BY THE SAFETY BELT/VEHICLE MANUFACTURER FOR
APPROVAL OF SAFETY BELT/RESTRAINT SYSTEMS**A-1 GENERAL****A-1.1** Make (trade name of manufacturer);**A-1.2** Type and general commercial description(s);**A-1.3** Name and address of manufacturer; and**A-1.4** Address(es) of assembly plant(s).**A-2 LIST OF VEHICLE(S) TO WHICH THE
DEVICE IS INTENDED TO BE FITTED (IF
APPLICABLE)****A-3 DESCRIPTION OF THE DEVICE****A-3.1 Safety Belt****A-3.1.1** Configuration of safety belt (two point belt, three point belt, static, automatic).**A-3.1.2** Details of webbing (material, weave, dimensions and colour).**A-3.1.3** Type of retractor and classify further in the case of emergency locking retractor — simple locking type, or webbing clamp type (*see* 3.7).**A-3.1.4** Information on additional functions, if applicable.**A-3.1.5** Drawings of the rigid parts.**A-3.1.6** Type of buckle (*see* 3.3).**A-3.1.7** Diagram of the safety belt assembly enabling identification and location of the rigid parts.**A-3.1.8** Mounting instructions showing, inter-alia, the installation of the retractor and its sensing device.**A-3.1.9** If a belt adjustment device for height is present, state whether it is considered to be part of the belt.**A-3.1.10** In the case of a pre-loading device or system, a full technical description of the construction and function including any sensing device, describing the method of activation and any necessary method to avoid inadvertent activation.**A-3.2 Restraint System****A-3.2.1** Drawings of the relevant parts of the vehicle structure and any seat anchorage reinforcements.**A-3.2.2** Drawings of the seat, showing its structure, adjustment system and fixing components, with an indication of the materials used.**A-3.2.3** Drawing or photograph of the restraint system as installed.**A-4 DESCRIPTION OF THE VEHICLE**

Photographs and/or drawings of a representative vehicle.

A-5 BODY WORK**A-5.1 Seats****A-5.1.1 Number****A-5.1.2 Position and Arrangement****A-5.1.3 Characteristics** — For seats non-type-approved as components, description and drawings of:**A-5.1.3.1** The seats and their anchorages;**A-5.1.3.2** The adjustment system;**A-5.1.3.3** The displacement and locking systems; and**A-5.1.3.4** The seat belt anchorages if incorporated in the seat structure.**A-5.2 Safety Belts and/or Other Restraint Systems**

<i>Row of Seat</i>	<i>Location²⁾</i>	<i>Type of Seat Belt</i>	<i>Variant (if applicable)</i>	<i>Belt Adjustment Device for Height (indicate yes/ no/optional)</i>
First row of seats	L			
	C			
	R			
Second row of seats ¹⁾	F			
	M			
	B			

¹⁾ The table may be extended as necessary for vehicles with more than two rows of seats or if there are more than three seats across the width of the vehicle.²⁾ (L = left-hand side, R = right-hand side, C = centre).

ANNEX B
(Clause 5.1.1)

TEST CHAMBER FOR CORROSION TEST

B-1 TEST APPARATUS

B-1.1 The apparatus shall consist of a mist chamber, a salt solution reservoir, supply of compressed air, one or more atomizing nozzles, sample supports, provision of heating the chamber and the necessary means of control. The size and detailed construction of the apparatus shall be optional provided that the test conditions are met.

B-1.2 It is important to ensure that drops of solution accumulated on the ceiling or cover of the chamber do not fall on test samples.

B-1.3 Drops of solution which fall from test samples shall not return to the reservoir for re-spraying.

B-1.4 The apparatus shall not be constructed of materials that will affect the corrosiveness of the mist.

B-2 LOCATION OF TEST SAMPLES IN THE MIST CABINET

B-2.1 Samples except retractors, shall be supported or suspended between 15° and 30° from the vertical and preferably parallel to the principal direction of horizontal flow of mist through the chamber, based upon the dominant surface being tested.

B-2.2 Retractors shall be supported or suspended so that the axes of the reel for storing the strap shall be normal to the principle direction of horizontal flow of mist through the chamber. The strap opening in the retractor shall also be facing in this principle direction.

B-2.3 Each sample shall be placed so as to permit free setting of mist on all samples.

B-2.4 Each sample shall be so placed to prevent salt solution from one sample dripping on to any other samples.

B-3 SALT SOLUTION

B-3.1 The salt solution shall be prepared by dissolving 5 ± 1 parts by mass of sodium chloride in 95 parts of distilled water. The salt shall be sodium chloride substantially free of nickel and copper and containing on the dry basis not more than 0.1 percent of sodium iodide and not more than 0.3 percent of the total impurities.

B-3.2 The solution shall be such that when atomized at 35°C the collected solution is in the pH range of 6.5 to 7.2.

B-4 AIR SUPPLY

The compressed air supply to the nozzle for atomizing the salt solution shall be free of oil and dirt and maintained at a pressure between 70 kPa and 180 kPa.

B-5 CONDITIONS IN THE MIST CHAMBER

B-5.1 The exposure zone of the mist chamber shall be maintained at $35 \pm 5^\circ\text{C}$. Two clean mist collectors shall be placed within the exposure zone to prevent drops of solution from the test samples or any other source from accumulating. The collectors shall be placed near the test samples, one as near as possible to the nozzles and the other as far away as possible from the nozzles. The mist shall be such that, for each 80 cm^2 of horizontal collecting area, an average of between 1.0 and 2.0 ml of solution per hour is collected in each collector when measured over at least 16 h.

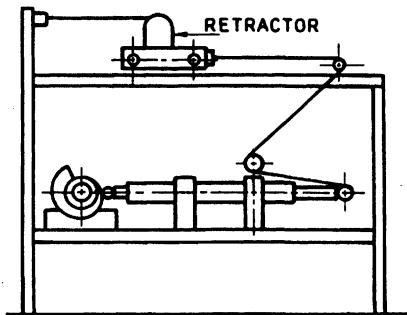
B-5.2 The nozzle or nozzles shall be directed or baffled in such a manner that the spray does not strike directly onto the test samples.

ANNEX C

(Clause 5.3.2.4)

TYPICAL APPARATUS TO TEST LOCKING OF EMERGENCY LOCKING RETRACTORS

C-1 A suitable apparatus is illustrated below and consist of a motor-driven cam, the follower of which is attached by wires to a small trolley mounted on a track. The cam follower incorporates a 'lost-motion' device which absorbs any movement should be reel lock before the full stroke of the follower is completed. The cam design and motor speed combination is such



as to give the required acceleration at a rate of increase of acceleration as specified in 5.3.2.4 and the stroke is arranged to be in excess of maximum permitted strap movement before locking.

C-2 On the trolley a carrier is mounted which can be swivelled to enable the retractor to be mounted in varying positions relative to the direction of movement of the trolley.

C-3 When testing retractors for sensitivity to strap movement, the retractor is mounted on a suitable fixed bracket and the strap is attached to the trolley.

C-4 When carrying out the above tests, any brackets, supplied by the manufacturer or his representative shall be incorporated in the test installation to simulate as closely as possible the intended installation in a vehicle.

C-5 Any additional brackets, that may be required to simulate the installation as intended in a vehicle shall be provided by the manufacturer or his representative.

ANNEX D

(Clauses 5.5.2.1 and 5.6)

DESCRIPTION OF TROLLEY, SEAT, ANCHORAGES, STOPPING DEVICE AND MANIKIN FOR DYNAMIC TEST

D-1 TROLLEY

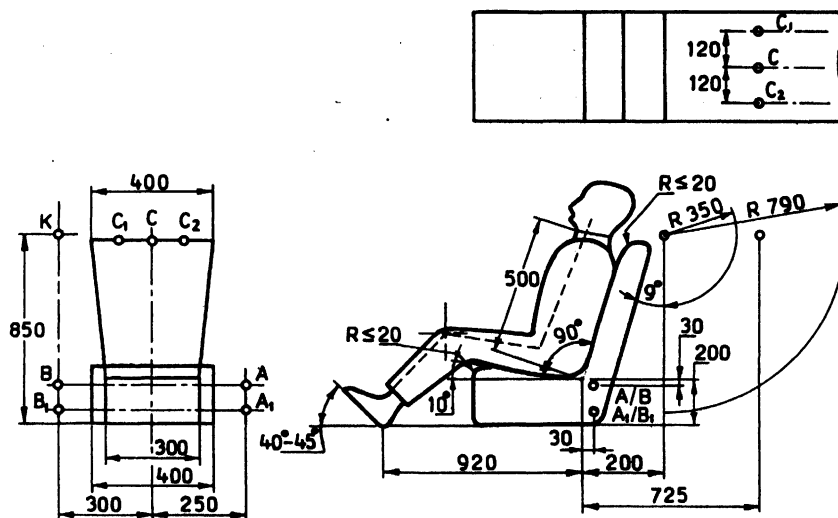
For tests on safety belts the trolley carrying the seat only, shall have a mass of 400 ± 20 kg. For tests on restraint systems the trolley, with the vehicle structure attached, shall have a mass of 800 kg. However, if necessary, the total mass of the trolley and vehicle structure may be increased by increments of 200 kg and shall not differ from the nominal value by more than ± 40 kg.

D-2 SEAT

The seat shall be of rigid construction and present a smooth surface, except in the case of tests on restraint systems. The particulars given in Fig. 1 shall be followed, care being taken that no metal part can come into contact with the belt.

D-3 ANCHORAGES

D-3.1 The anchorages shall be positioned as shown in Fig. 15. The circular marks, which correspond to the arrangement of the anchorages, show where the ends of the belt are to be connected to the trolley or to the load transducer, as the case may be. The anchorages for normal use are the points A, B and K if the strap length between the upper edge of the buckle and hole for the attachment of the strap support is not more than 250 mm. Otherwise, the points A₁ and B₁ shall be used. The structure carrying the anchorages shall be rigid. The upper anchorage must not be displaced by more than 0.2 mm in the longitudinal direction when a load of 1 kN is applied to it in that direction. The trolley shall be so constructed that no permanent deformation shall occur in the parts bearing the anchorages during the test.



All dimensions in millimetres.

FIG. 15 TROLLEY, SEAT, ANCHORAGE

D-3.2 The tolerance on the position of the anchorage points is such that each anchorage point shall be situated at the most at 50 mm from corresponding points *A*, *B* and *K* indicated in Fig. 15, or *A*₁, *B*₁ and *K*₁ as the case may be.

D-3.3 If a fourth anchorage is necessary in order to attach the retractor, this anchorage:

- shall be located in the vertical longitudinal plane passing through *K*₁;
- shall enable the retractor to be tilted to the angle prescribed by the manufacturer;
- shall be located on the arc of a circle with centre *K*₁ and with radius *KB*₁ = 790 mm, if the length between the upper strap guide and the strap outlet at the retractor is not less than 540 mm. In all other cases, the fourth anchorage shall be on the arc of a circle with centre *K* and radius 350 mm.

D-3.4 In the case of a belt equipped with a belt adjustment device for height, this shall be secured either to a rigid frame or to a part of the vehicle on which it is normally mounted which shall be securely fixed on the test trolley.

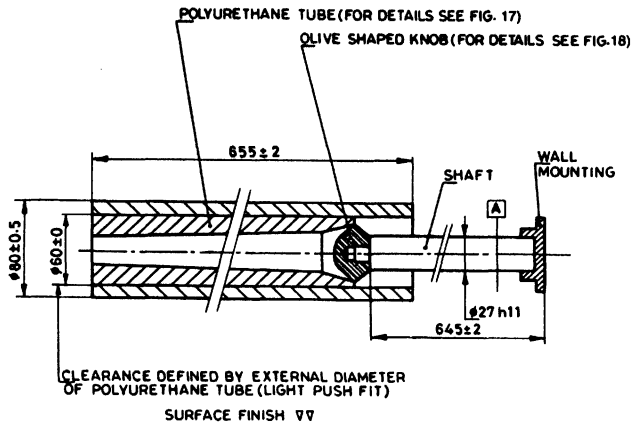
D-4 STOPPING DEVICE

D-4.1 This device consists of two identical absorbers mounted in parallel, except in the case of restraint systems when four absorbers shall be used for a nominal mass of 800 kg. If necessary, an additional absorber shall be used for each 200 kg increase of nominal mass.

D-4.2 Each absorber comprises

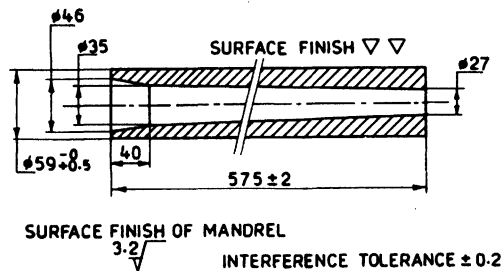
- an outer casing formed from a steel tube,
- a polyurethane energy-absorber tube,
- a polished-steel olive-shaped knob penetrating into the absorber, and
- a shaft and an impact plate.

D-4.3 The dimensions of the various parts of this energy absorber are shown in Fig. 16, 17 and 18. The characteristic values of the energy-absorbing material are given below. Immediately before each test, the tubes must be conditioned at a temperature between 15 and 25°C for minimum 12 h without being used. The temperature of the stopping device during the dynamic testing of safety belts and restraint systems must be the same as during the calibration test to within $\pm 2^\circ\text{C}$.



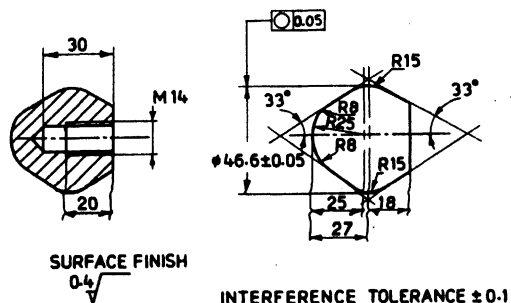
All dimensions in millimetres.

FIG. 16 STOPPING DEVICE



All dimensions in millimetres.

FIG. 17 STOPPING DEVICE (POLYURETHANE TUBE)



All dimensions in millimetres.

FIG. 18 STOPPING DEVICE (OLIVE-SHAPED KNOB)

D-4.4 Characteristic Values of the Energy-Absorbing Material (ASTM Method D 2000 and Unless Otherwise Stated)

D-4.4.1 Shore Hardness A: 95 ± 2 at $20 \pm 5^\circ\text{C}$

D-4.4.2 Breaking strength: $R_o \geq 343 \text{ daN/cm}^2$

D-4.4.3 Minimum elongation: $A_o \geq 400$ percent

D-4.4.4 Modulus:

a) At 100 percent elongation: $\geq 108 \text{ daN/cm}^2$

b) At 300 percent elongation: $\geq 235 \text{ daN/cm}^2$

D-4.4.5 Low-Temperature Brittleness
[IS 3400 (Part 18)]: 5 h at -55°C

D-4.4.6 Compression set 22 h at 70°C
(Method B): ≤ 45 percent

D-4.4.7 Density at 25°C : 1.05–1.10

D-4.4.8 Ageing in air [(IS 3400 (Part 4)/IS 3400 (Part 9)]

D-4.4.9 70 h at 100°C :

- a) Shore hardness A : maximum variation ± 3
- b) Breaking strength: decrease < 10 percent of R_o
- c) Elongation: decrease < 10 percent of A_o
- d) Mass: decrease < 1 percent

D-4.4.10 Immersion in Fluids

D-4.4.10.1 Immersion in oil (ASTM Method No. 1 oil): 70 h at 100°C

- a) Shore hardness A : maximum variation ± 4
- b) Breaking strength: decrease < 15 percent of R_o
- c) Elongation: decrease < 10 percent of A_o
- d) Volume: swelling < 5 percent

D-4.4.10.2 Immersion in oil (ASTM Method No. 3 oil): 70 h at 100°C :

- a) Breaking strength: decrease < 15 percent of R_o
- b) Elongation: decrease < 10 percent of A_o
- c) Volume: swelling < 5 percent

D-4.4.10.3 Immersion in distilled water:

One week at 70°C

- a) Breaking strength: decrease < 35 percent of R_o
- b) Elongation: decrease < 20 percent of A_o

D-4.5 The requirements relating to the stopping device are given in 4.6 below. Any other device giving equivalent results is acceptable.

D-4.6 Trolley Deceleration Requirements

D-4.6.1 The deceleration curve of the trolley weighted with inert masses to produce a total of 455 ± 20 kg for safety belt tests and 910 ± 40 kg for restraint system tests, where the nominal mass of the trolley and vehicle structure is 800 kg, must remain within the hatched area in Fig. 19. If necessary, the nominal mass of the trolley and attached vehicle structure can be increased by increments of 200 kg, in which case an additional inert mass of 28 kg shall be added per increment. In no case shall be total mass of the trolley, the vehicle structure and the inert masses differ from the nominal value for calibration tests by more than ± 40 kg. The stopping distance during calibration of the trolley shall be 400 ± 20 mm and the speed of the trolley shall be 50 ± 1 km/h.

D-4.6.2 In both the above cases the measurement equipment shall have a response which is substantially flat up to 60 Hz with a roll off at 100 Hz in accordance with ISO 6487. Mechanical resonances associated with transducer mounting may not distort readout data. Consideration may be given to the effect of cable length and temperature of frequency response.

D-5 MANIKIN

D-5.1 Specifications of the Manikin

D-5.1.1 General

The main characteristics of the manikin are indicated in the following figures and tables:

Fig. 20 Side view of head, neck and torso;

Fig. 21 Front view of head, neck and torso;

Fig. 22 Side view of hip, thighs and lower leg;

Fig. 23 Front view of hip, thighs and lower leg;

Fig. 24 Principal dimensions;

Fig. 25 Manikin in sitting position, showing:

- a) Location of the centre of gravity;
- b) Location of points at which displacement shall be measured; and
- c) Shoulder height;

Table 2 Mass of head, neck, torso, thigh and lower leg; and

Table 3 References, names, materials and principal dimensions of the components of the manikin.

D-5.1.2 Description of the Manikin

D-5.1.2.1 Lower leg structure (see Fig. 22 and 23)

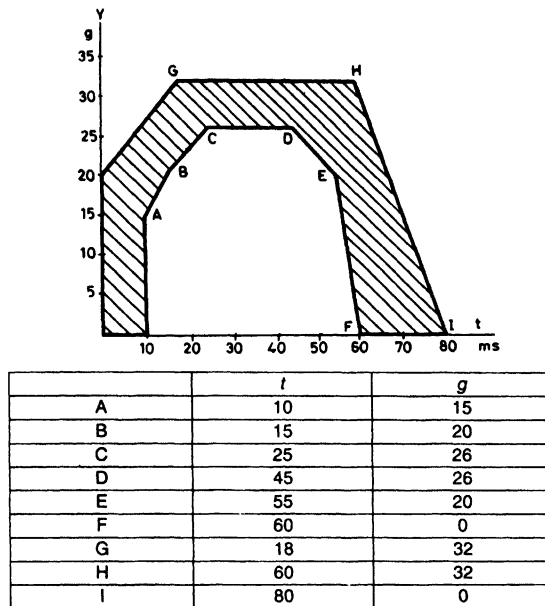


FIG. 19 DESCRIPTION OF THE CURVE OF TROLLEY DECELERATION AS FUNCTION OF TIME

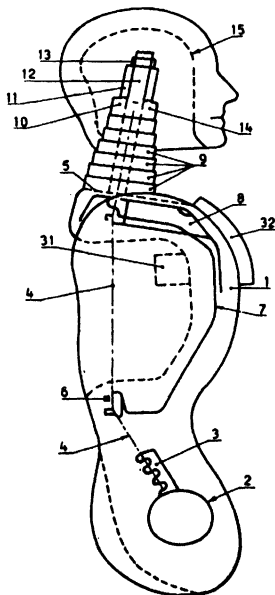


FIG. 20 MANIKIN — SIDE VIEW OF HEAD, NECK AND TORSO

The lower leg structure consists of three components:

- A sole plate (30),
- A shin tube (29), and
- A knee tube (26).

The knee tube has two lugs, which limit the movement of the lower leg in relation to the thigh. The lower leg can rotate rearwards about 120° from the straight position.

D-5.1.2.2 Thigh structure (see Fig. 22 and 23)

The thigh structure consists of three components:

- A knee tube (22),
- A thigh bar (21), and
- A hip tube (20).

Movement of the knee is limited by two cut-outs in the knee tube (22), which engage with the lugs of the leg

D-5.1.2.3 Torso structure (see Fig. 20 and 21)

The torso structure consists of the following components:

- A hip tube (2),
- A roller chain (4),
- Ribs (6) and (7),

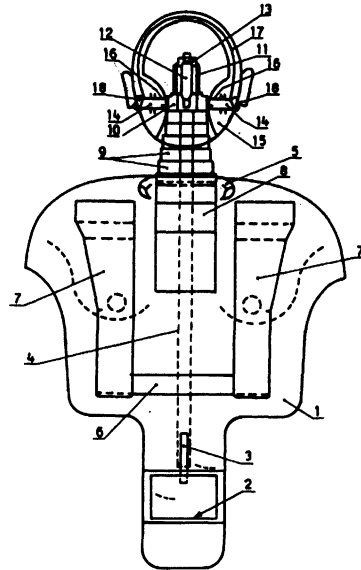


FIG. 21 MANIKIN — FRONT VIEW OF HEAD, NECK AND TORSO

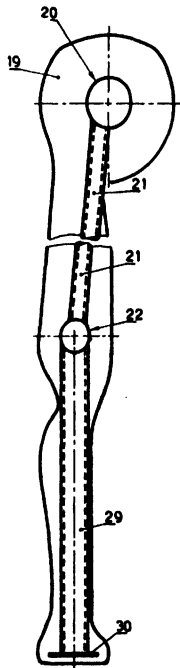


FIG. 22 MANIKIN — SIDE VIEW OF HIP, THIGHS AND LOWER LEG

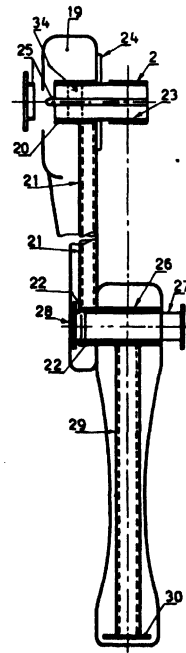
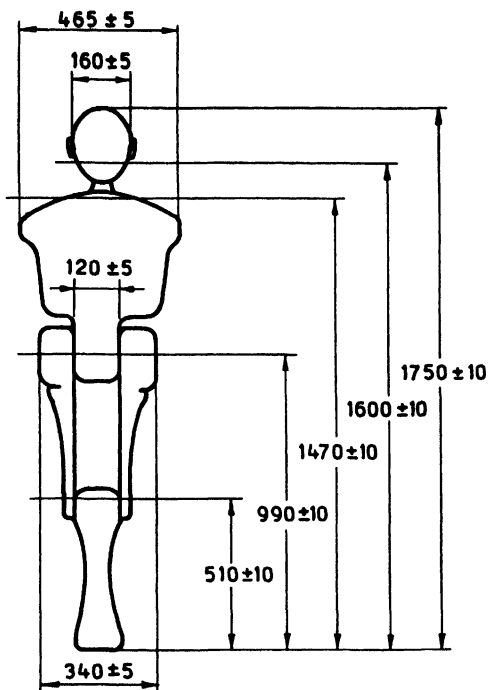
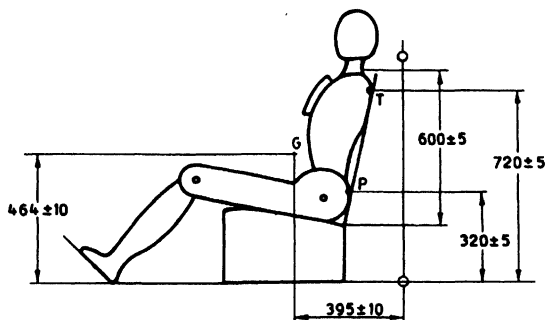


FIG. 23 MANIKIN — FRONT VIEW OF HIP, THIGHS AND LOWER LEG



All dimensions in millimetres.

FIG. 24 MANIKIN — PRINCIPLE DIMENSIONS



Manikin seated in a position shown in Fig. 15.

G = centre of gravity

T = torso measurement point (located at the centre line of the manikin)

P = pelvis measurement point (located at the back on the centre of line of the manikin)

All dimensions in millimetres.

FIG. 25 MANIKIN IN SEATED POSITION

- d) A sternum (8), and
- e) Chain attachments (3 and, partly, 7 and 8).

D-5.1.2.4 Neck (see Fig. 20 and 21)

The neck consists of seven polyurethane discs (9). The degree of stiffness of the neck can be adjusted by means of a chain tensioner.

D-5.1.2.5 Head (see Fig. 20 and 21)

The head (15) is hollow; the polyurethane is reinforced by steel bands (17). The chain tensioner which enables the neck to be adjusted consists of a polyamide block (10), a tubular spacer (11) and a tensioning component (12 and 13). The head can rotate at the joint between the first and second cervical vertebrae (the atlas-axis joint), which consists of an adjuster assembly (14 and 18), a spacer (16) and a polyamide block (10).

D-5.1.2.6 Knee joint (see Fig. 23)

The lower leg and thighs are connected by a tube (27) and a tensioner (28).

D-5.1.2.7 Hip joint (see Fig. 23)

The thighs and torso are connected by a tube (23), friction plates (24) and a tensioner (25).

D-5.1.2.8 Polyurethane

- a) Type: PU 123 CH compound
- b) Hardness: 50 to 60 shore A

D-5.1.2.9 Overall

The manikin is covered by a special overall.

D-5.2 Correction of the Mass

In order to calibrate the manikin to certain values and its total mass, the mass distribution must be adjusted by means of six correction weights of 1 kg each which can be fitted to the hip joint. Six other polyurethane weights of 1 kg each can be fitted to the back of the torso.

D-5.3 Cushion

A cushion shall be positioned between the chest of the manikin and the overall. This cushion must be made of polyurethane foam complying with the following specification:

- a) Hardness: 7 to 10 shore A
- b) Thickness: 25 ± 5 mm

It may be replaceable.

D-5.4 Adjustment of the Joints**D-5.4.1 General**

In order to achieve reproducible results, it is necessary to specify and control the friction at each joint.

D-5.4.2 Knee Joint

- a) Tighten the knee joint;
- b) Set the thigh and lower leg vertical;
- c) Rotate the lower leg through 30° ;
- d) Gradually slacken the tensioner until the lower leg starts to fall under its own weight; and
- e) Lock the tensioner in this position.

D-5.4.3 Hip Joints

- a) Increase the rigidity of the hip joints for the purpose of adjustment;
- b) Place the thighs in horizontal position and the torso in a vertical position;
- c) Rotate the torso towards until it forms an angle of 60° with the thighs;
- d) Gradually slacken the tensioner until the torso starts to fall under its own weight; and
- e) Lock the tensioner in this position.

D-5.4.4 Atlas-Axis Joint

- a) Adjust the atlas-axis joint so that it just resists its own weight; and
- b) Lock the tensioner in this position.

D-5.4.5 Neck

- a) The neck can be adjusted by means of the chain tensioner (13); and
- b) When the neck is adjusted, the upper end of the tensioner shall be displaced between 40 and 60 mm when subjected to horizontal load of 100 N.

Table 2 Mass of Head, Neck, Torso, Thigh and Lower Leg
(Clause D-5.1.1)

Components of Manikin (1)	Mass (kg) (2)
Head and neck	4.6 ± 0.3
Torso and arms	40.3 ± 1.0
Thighs	16.2 ± 0.5
Lower leg and foot	9.0 ± 0.5
Total mass including correction weights	75.5 ± 1.0

Table 3 References, Names, Materials and Principal Dimensions of the Components of the Manikin
(Clause D-5.1.1)

Reference Number	Names	Materials	Dimensions (mm)
1	Body Material	polyurethane	—
2	Hip tub	steel	76 × 70 × 100
3	Chain-attachments	steel	25 × 10 × 70
4	Roller chain	steel	0.75
5	Shoulder plate	polyurethane	—
6	Rolled section	steel	30 × 30 × 3 × 250
7	Ribs	perforated steelplate	400 × 85 × 1.5
8	Sternum	perforated steelplate	250 × 90 × 1.5
9	Discs (six)	polyurethane	90 dia × 20 80 dia × 20 75 dia × 20 70 dia × 20 65 dia × 20 60 dia × 20
10	Block	polyamide	60 × 60 × 25
11	Tubular spacer	steel	40 × 40 × 2 × 50
12	Tensioning bolt	steel	M16 × 90
13	Tensioner nut	steel	M16
14	Tensioner for atlas axis joint	steel	12 dia × 130
15	Head	polyurethane	—
16	Tubular spacer	steel	18 dia × 13 × 17
17	Reinforced plate	steel	30 × 3 × 500
18	Tensioner nut	steel	M12
19	Thighs	polyurethane	—
20	Hip tube	steel	76 × 70 × 80
21	Thigh bar	steel	30 × 30 × 440
22	Knee tube	steel	52 × 46 × 40
23	Hip connection tube	steel	70 × 64 × 250
24	Friction plates (four)	steel	160 × 75 × 1
25	Tensioner assembly	steel	M12 × 320 Plates and nuts
26	Knee tube	steel	52 × 46 × 160
27	Knee connection tube	steel	44 × 39 × 190
28	Tensioner plate	steel	70 dia × 4
29	Shin tube	steel	50 × 50 × 2 × 460
30	Sole plate	steel	100 × 170 × 3
31	Torso correction mass (six)	polyurethane	Each mass 1 kg
32	Cushion	polystyrene foam	350 × 250 × 25
33	Overall	cotton and polyamide straps	—
34	Hip correction masses (six)	steel	Each mass 1 k

ANNEX E**(Foreword)****COMMITTEE COMPOSITION**

Automotive Body, Chassis Accessories and Garage Equipment Sectional Committee, TED 6

<i>Organization</i>	<i>Representative(s)</i>
Association State Road Transport Undertaking, New Delhi	DR M. KOTEESHWARAN (<i>Chairman</i>)
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